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Proximity of Delaware Sanitary Landfills to Wetlands and Deepwater Habitats: Statewide Results

Florida State Univ., Tallahassee

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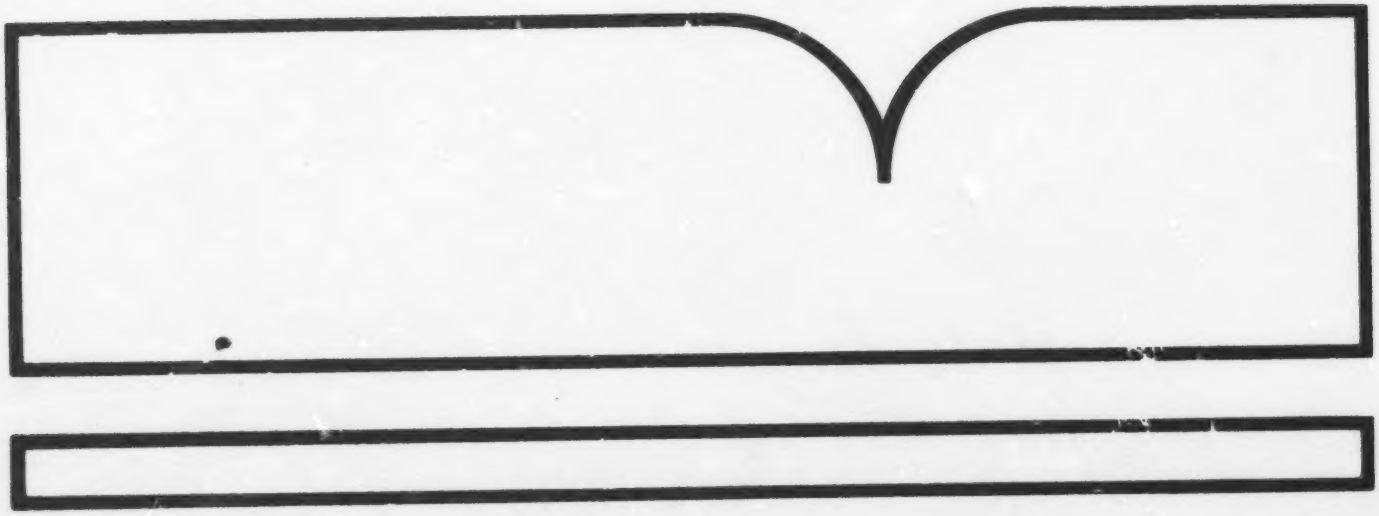

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16. ABSTRACT

Sanitary landfills can cause considerable harm to sensitive ecosystems if they are not properly located, designed, and managed. The purpose of this report is to document the proximity of sanitary landfills included in this study in Delaware to wetlands and deepwater habitats (i.e., rivers, lakes, streams, bays, etc.). The sanitary landfills were identified on U.S. Fish and Wildlife Service's National Wetlands Inventory maps. The nearness or proximity of the sanitary landfills to wetlands and deepwater habitats was determined by drawing three concentric regions around the point representing the location of each landfill. The radii of the concentric regions were: 1/4 mile, 1/2 mile, and 1 mile. A companion report summarizes the statewide results. The data on individual landfills include: (1) general facility/site data, and (2) wetlands/deepwater habitat data. These facilities have the potential to adversely affect sensitive ecosystems, such as wetlands and deepwater habitats, either through habitat alterations or through the migration of contaminants from sanitary landfills.

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PROXIMITY OF DELAWARE SANITARY LANDFILLS TO WETLANDS AND DEEPWATER HABITATS
Statewide Results

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ABSTRACT

Sanitary landfills can cause considerable harm to sensitive ecosystems if they are not properly located, designed, and managed. The purpose of this report is to summarize the proximity of sanitary landfills in the state of Delaware to wetlands and deepwater habitats (i.e., rivers, lakes, streams, bays, etc.); a companion report presents data on individual landfills. The source of data used to determine the locations of the sanitary landfills was the computer data file developed by Development Planning and Research Associates, Inc. for use by the U.S. Environmental Protection Agency's Office of Solid Waste in its RCRA Subtitle D program. The sanitary landfills were identified on U.S. Fish and Wildlife Service's National Wetlands Inventory maps. The nearness or proximity of the sanitary landfills to wetlands and deepwater habitats was determined by drawing three concentric regions around the point representing the location of each landfill. The radii of the concentric regions were: 1/4 mile, 1/2 mile, and 1 mile. All sanitary landfills in the state of Delaware are located in or are close to either wetlands or deepwater habitats. These facilities have the potential to adversely affect sensitive ecosystems, such as wetlands and deepwater habitats, either through habitat alterations or through the migration of contaminants from sanitary landfills.

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INTRODUCTION

Sanitary landfills, as typically defined, are waste management facilities regulated under Subtitle D of the Resource Conservation and Recovery Act (RCRA). These facilities are commonly referred to as municipal waste landfills and they are primarily used to receive household refuse and nonhazardous commercial waste. However, sanitary landfills also receive other types of Subtitle D waste, such as sewage sludge and industrial wastes. Sanitary landfills typically receive some hazardous waste in the form of household hazardous waste, and hazardous waste from small quantity generators as defined in 40 CFR Part 261.10 (Definitions). Depending upon the definition of a sanitary landfill used by the individual states, there are between 6,500 and 9,300 of these facilities permitted in the United States (U.S. EPA, 1987).

Sanitary landfills can cause considerable harm to sensitive ecosystems if they are not properly located, designed, and managed. These facilities have the potential to adversely affect sensitive ecosystems, such as wetlands and deepwater habitats, either through habitat alterations or through the migration of contaminants from sanitary landfills. In order to evaluate the seriousness of this problem, information is needed on the nearness of sanitary landfills to wetlands and surface water bodies. The purpose of this study is to document the proximity of sanitary landfills in the state of Delaware to wetlands and deepwater habitats (i.e., rivers, lakes, streams, bays, etc.). This report gives statewide summary results; a companion report, "Proximity of Delaware Sanitary Landfills to Wetlands and Deepwater Habitats, Data on Individual Landfills," presents data on the individual landfills.

CONCLUSIONS

1. All sanitary landfills in the state of Delaware are located in or are close to either wetlands or deepwater habitats.

2. These facilities have the potential to adversely affect sensitive ecosystems, such as wetlands and deepwater habitats, either through habitat alterations or through the migration of contaminants from sanitary landfills.

MATERIALS AND METHODS

The source of data used to determine the locations of the sanitary landfills was the computer data file developed by Development Planning and Research Associates, Inc. (DPRA) for use by the U.S. Environmental Protection Agency's Office of Solid Waste in its RCRA Subtitle D program (DPRA, 1986). The DPRA data file includes information on 7,683 sanitary landfills, and 6,849 of these facilities have latitude and longitude coordinates in degrees, minutes, and seconds specified in the data file. Each set of coordinates defines a point which represents the geographic location of a sanitary landfill (Figure 1). In addition, the data file contains the names of the landfills and data on the cities or counties in which the landfills reside. Individual states are responsible for permitting sanitary landfills under Subtitle D of RCRA and, since DPRA obtained the information for the data file from state sources, the site location information varies in terms of accuracy and the point chosen to represent the location of each facility.

Four types of errors or omissions were identified in the DPRA data file. These errors and omissions include: missing latitude and longitude, missing state code, wrong state code, and erroneous latitude/longitude. The first two items relate to data that were omitted in the facility record. Facilities that did not have latitude and longitude coordinates were not used in this study while facilities that did not have a state code were assigned an appropriate state code by comparing the latitude and longitude coordinates for the facilities with maps of the various states. The last two items relate to errors in the data file. Facilities with the wrong state code were corrected and included in the study. The last item relates to erroneous latitude and/or longitude records. Where discovered, the erroneous coordinate(s) were corrected, if possible. Errors may still exist in the DPRA data file; however, it is believed that the overall results and conclusions contained in this report will not be significantly affected, since the number of errors is probably small.

Wetlands typically form part of a continuous transition zone between uplands and open water. Therefore, the delineation of the upper and lower boundaries in any wetland definition is somewhat arbitrary. There are a number of definitions of wetlands that have been developed for use in classifying natural environments or for regulatory purposes. While these definitions are not identical, they are very similar. The selection of a specific definition for use in

this study was determined by the availability of national wetlands and deepwater habitats geographic data.

The most extensive, consistent source of wetlands and deepwater habitats geographic data is the U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI). The NWI has developed detailed, large-scale maps for a significant portion of the United States. To date, wetland maps have been developed for approximately 40 percent of the contiguous 48 states, 10 percent of Alaska, and all of Hawaii. Large-scale NWI maps typically are either 1:24,000 scale or 1:63,360 scale U.S. Geological Survey quadrangle maps; however, most are 1:24,000 scale. Wetlands and deepwater habitats are delineated on the NWI maps. The delineation of wetlands and deepwater habitats was developed using remote sensing techniques and field investigations. The NWI maps are developed in accordance with the National Map Accuracy Standard (NMAS) (U.S. GS, 1979). The NWI 1:24,000 scale maps used in this study are accurate, according to the NMAS, to within 40 feet of ground measurements. These maps are particularly useful for plotting the location of sanitary landfills and for determining the proximity of these facilities to wetlands and deepwater habitats.

The NWI maps use the definitions (contained in Tables 1 and 2) and the classification system (contained in Table 3) for wetlands and deepwater habitats developed by the U.S. Fish and Wildlife Service (Cowardin et al., 1979). Wetlands are defined as lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water. Deepwater habitats are defined as permanently flooded lands lying below the deepwater boundary of wetlands. For more expansive definitions and an explanation of the definitions, as well as the boundary limits, see Tables 1 and 2; for further details see Cowardin et al. (1979). The U.S. Fish and Wildlife Service's classification of wetlands and deepwater habitats is hierarchical in nature proceeding from general to specific (Cowardin et al., 1979). There are 5 systems, 10 subsystems, and 55 classes. In this study only the "system", i.e, the complex of wetlands and deepwater habitats that share the influence of similar hydrologic, geomorphologic, chemical, or biological factors, was used for classification purposes. The definitions as well as the boundary limits of the five systems, i.e., Marine, Estuarine, Riverine, Lacustrine, and Palustrine, are given in Table 3; for further details see Cowardin et al. (1979). The first four systems, i.e., Marine, Estuarine, Riverine, and Lacustrine, include both wetlands and deepwater habitats whereas the Palustrine System includes only wetlands.

In order to link the location of sanitary landfills in the DPRA data file to the appropriate NWI maps, we used the information on the T-70 computer tape obtained from the U.S. Geological Survey (National Cartographic Information Center, 1987). The NWI large-scale maps were developed using U.S. Geological Survey's quadrangle maps as base maps. The T-70 computer tape contains 67 fields of information including latitude and longitude that can be used for identifying the 1:24,000 scale maps, the map names, and the state codes assigned to the maps. Sanitary landfill location data on the DPRA computer file tape were matched by a computer program against location data on the US Geological Survey T-70 computer tape in order to identify the specific maps that contain sanitary landfills and/or that would be needed to evaluate the wetlands and deepwater habitats that are within 1 mile of each sanitary landfill. Sanitary landfills that were located on the edge or in the corner of a map required more than one map (i.e., two to four maps) to complete the interpretation. The map names obtained from the computer matching were sorted by state and compared with inventories of available NWI maps.

Each sanitary landfill included in this study was located on NWI large-scale maps using standard cartographic techniques. Nearness or proximity of sanitary landfills to wetlands and deepwater habitats was determined by drawing three concentric regions around the point representing the location of each landfill. The radii of the concentric regions were: 1/4 mile, 1/2 mile, and 1 mile (Figure 1). The occurrence or nonoccurrence of the wetland and deepwater habitat systems in each concentric region was then recorded.

Many sanitary landfills are typically of the order of 100 acres in size. For example, in the state of Florida about 35 percent of the active sanitary landfills are between 50 and 150 acres in size, with the average size being 110 acres (Florida Department of Environmental Regulation, 1987). A landfill that is 100 acres in size and uniformly distributed about its latitude/longitude point designation will have a radius of approximately 1/4 mile and, therefore, will approximate the boundary of the first concentric 1/4-mile radius region (Figure 1). Undoubtedly, most of the landfills located in a 1/4-mile radius region containing either wetlands or deepwater habitats should be considered to be located in wetlands or deepwater habitats. Since landfills vary considerably in size and shape, some of the landfills located in the 1/2-mile radius and 1-mile radius regions containing wetlands or deepwater habitats will probably also be located in wetlands or deepwater habitats. The exact geographic boundary of the landfill is not the critical consideration for determining adverse impacts associated with these facilities, since contaminants

can migrate off-site to affect wetlands and deepwater habitats.

RESULTS AND DISCUSSION

We obtained data on the proximity of 3 sanitary landfills in the state of Delaware to wetlands and deepwater habitats. There are 3 sanitary landfills in the DPRA data file for the state of Delaware and all of these facilities have NWI maps available for site interpretation.

Approximately 67 percent of the sanitary landfills are located in or within 1/4 mile of wetlands, while 100 percent are located in or within 1/2 mile of wetlands, (Table 4 and Figure 2). None of the landfills are located more than a mile from any type of wetland. All sanitary landfills are located either in or are close to Palustrine wetlands (approximately 33, and 100 percent are located in or within 1/4, and 1/2, respectively, of a Palustrine wetland). None of the sanitary landfills are located more than 1/2 mile from a wetland (Figure 3).

Approximately 33 percent (1 facility) of the sanitary landfills are located in or within 1/4 mile of deepwater habitats, while 33 and 67 percent are located in or within 1/2 and 1 mile of deepwater habitats, respectively (Table 5 and Figure 4). One (33 percent) of the landfills is located more than a mile from any type of deepwater habitat. The facilities that are located in or that are close to deepwater habitats are in the vicinity of Estuarine or Riverine deepwater habitats (i.e., 33 percent are located in or within 1 mile of a Estuarine deepwater habitat and 67 percent are located in or within 1 mile of a Riverine deepwater habitat). Approximately 33 percent are located more than 1 mile from the closest deepwater habitat (Figure 5), while 33 percent are located 1/2 to 1 mile from the closest deepwater habitat.

Approximately 67 percent of the sanitary landfills are located in or within 1/4 mile of either wetlands or deepwater habitats, while all are located in or within 1/2 mile of either wetlands or deepwater habitats (Table 6 and Figure 6). All of the sanitary landfills are located either in or are close to Palustrine habitats (approximately 33, and 100 percent are located in or within 1/4, and 1/2 mile, respectively, of a Palustrine habitat) while more than half of the sanitary landfills are located either in or are close to Riverine habitats, (approximately 33, 33, and 67 percent are located in or within 1/4, 1/2, and 1 mile, respectively, of a Riverine habitat). None of the sanitary landfills are

located more than 1/2 mile from either a wetland or deepwater habitat (Figure 7).

All of the sanitary landfills included in this study in the state of Delaware are located either in or are close to wetlands. From this, we conclude that these facilities have the potential to adversely affect sensitive ecosystems, such as wetlands, either through habitat alterations or through the migration of contaminants from sanitary landfills. In addition, two-thirds of the sanitary landfills included in this study in the state of Delaware are located either in or close to deepwater habitats and they also have the potential for adversely affecting these sensitive ecosystems.

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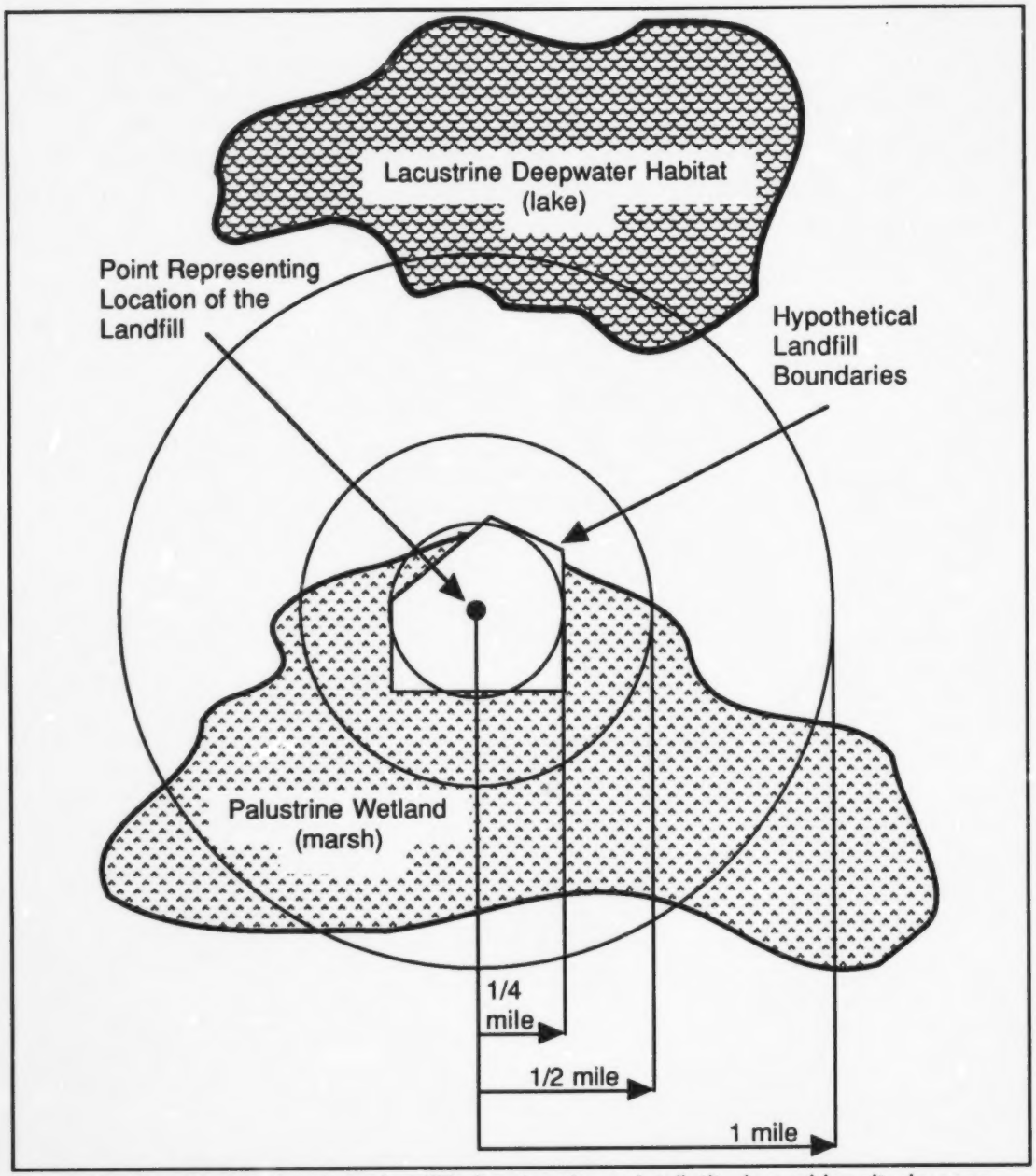

Figure 1. Hypothetical sanitary landfill showing the point (latitude and longitude coordinates) that represents the location of the landfill, the concentric regions used to determine the nearness or proximity of the sanitary landfill to wetlands and deepwater habitats, and the boundary of a 100-acre sanitary landfill distributed approximately evenly around its point location (a 100-acre sanitary landfill uniformly distriubted around a point will have a radius of approximately 1/4 mile).

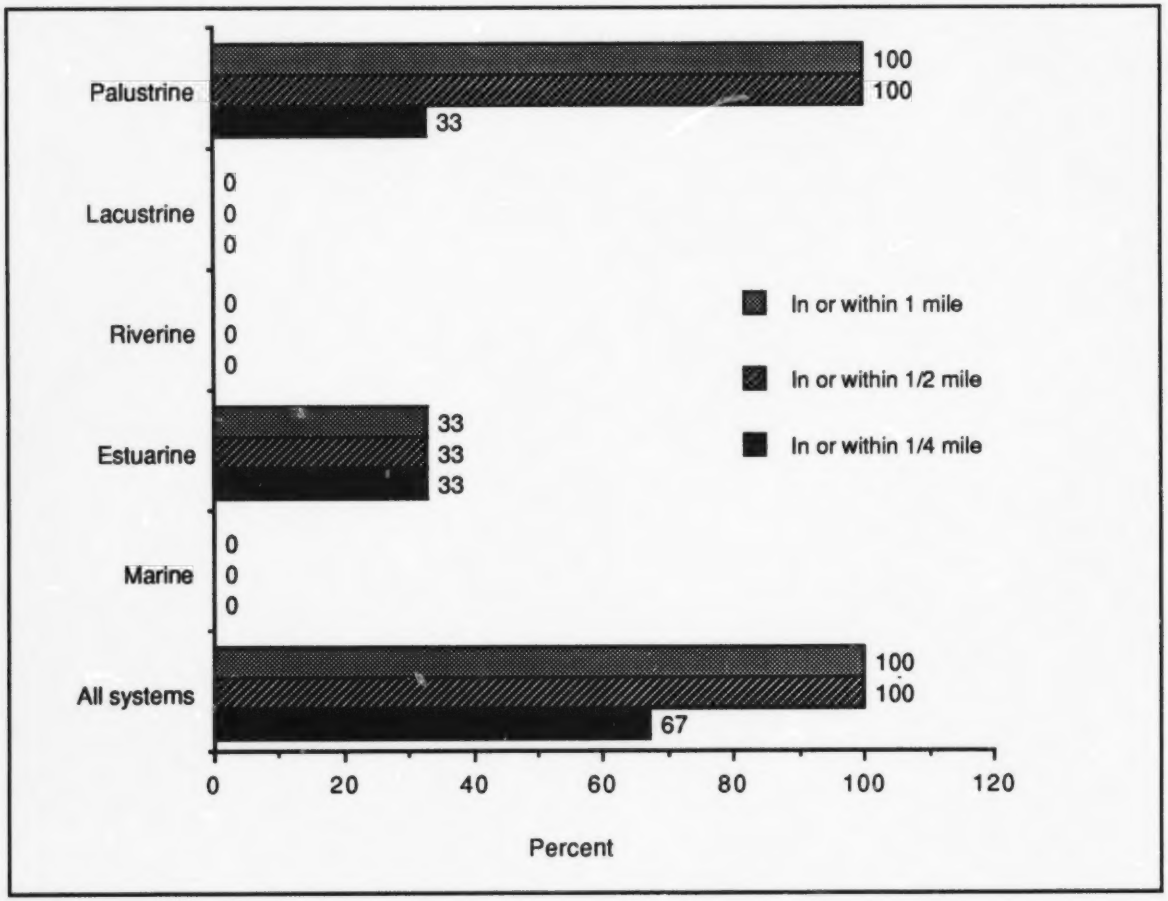

Figure 2. Proximity of 3 Delaware sanitary landfills to wetlands.

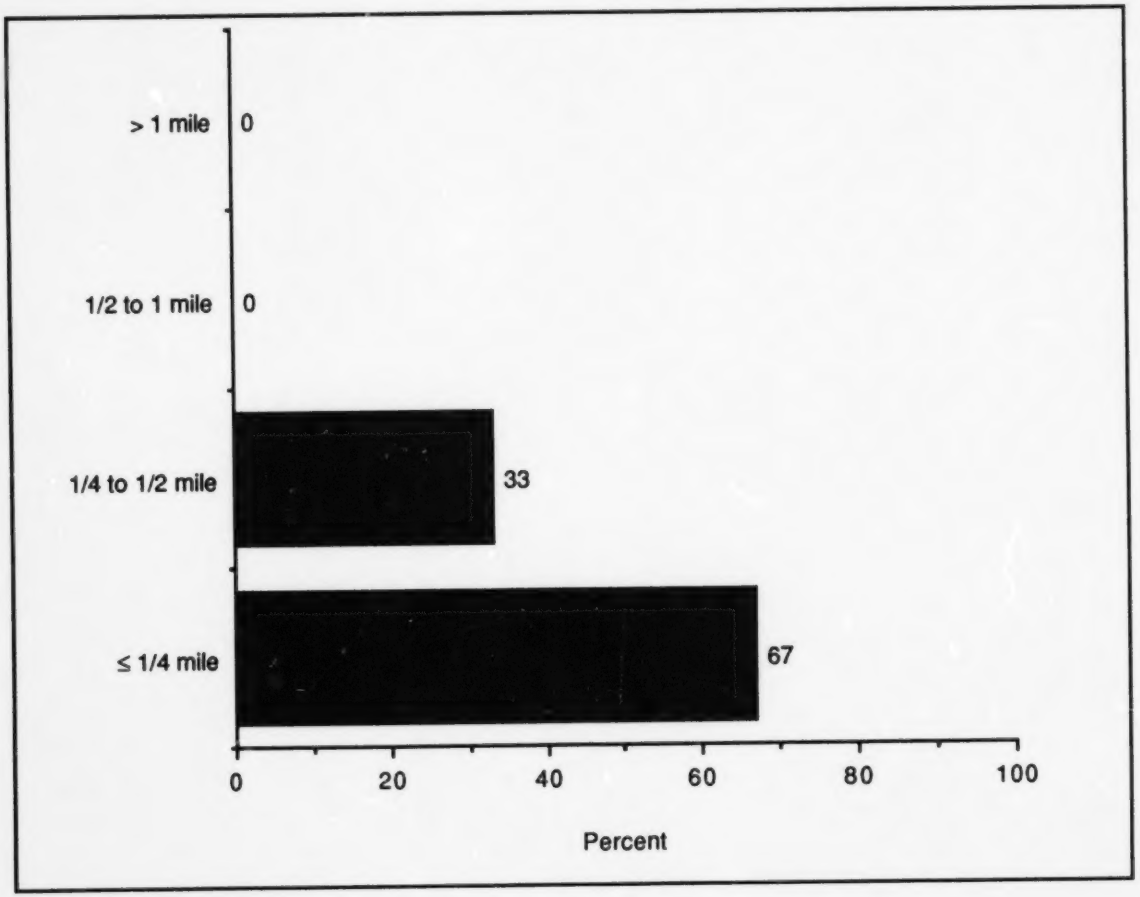

Figure 3. Distance of 3 Delaware sanitary landfills to the closest wetland.

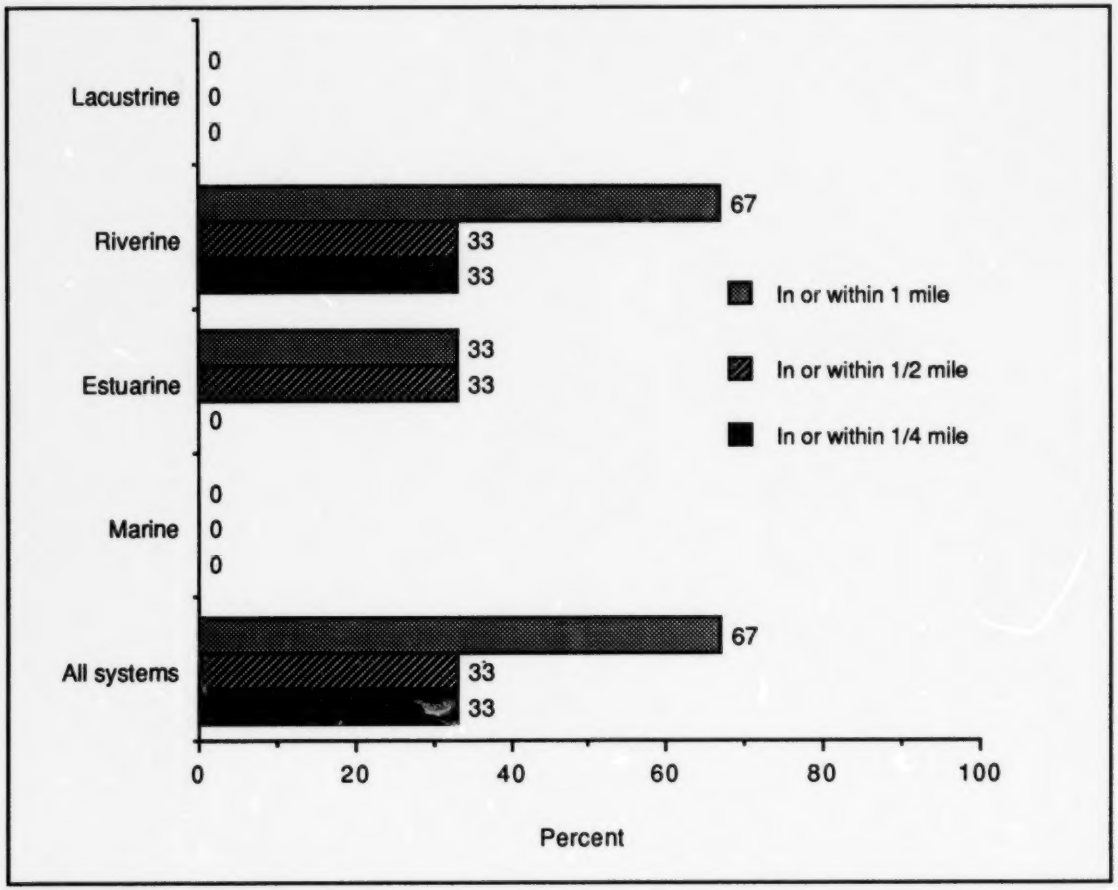

Figure 4. Proximity of 3 Delaware sanitary landfills to deepwater habitats.

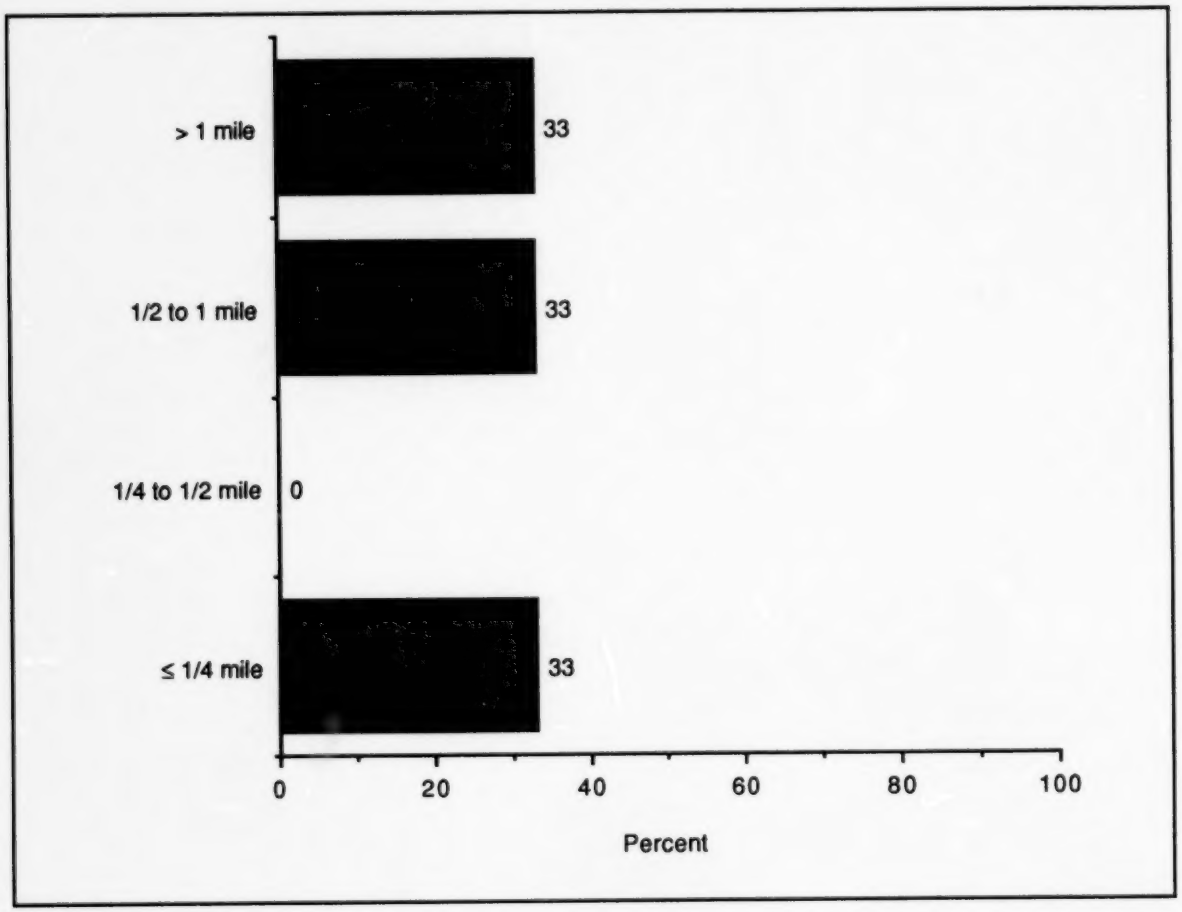

Figure 5. Distance of 3 Delaware sanitary landfills to the closest deepwater habitat.

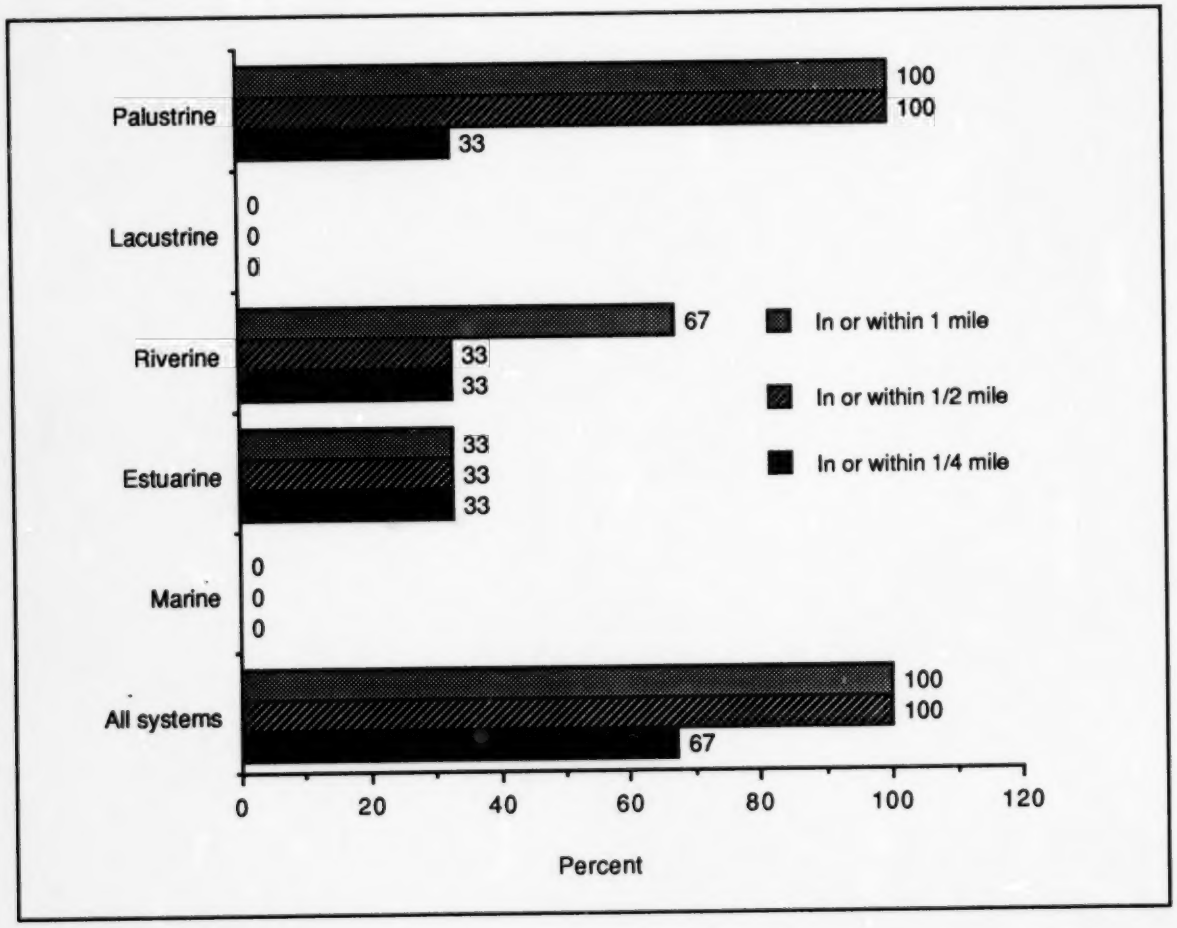

Figure 6. Proximity of 3 Delaware sanitary landfills to either closest wetland or deepwater habitat.

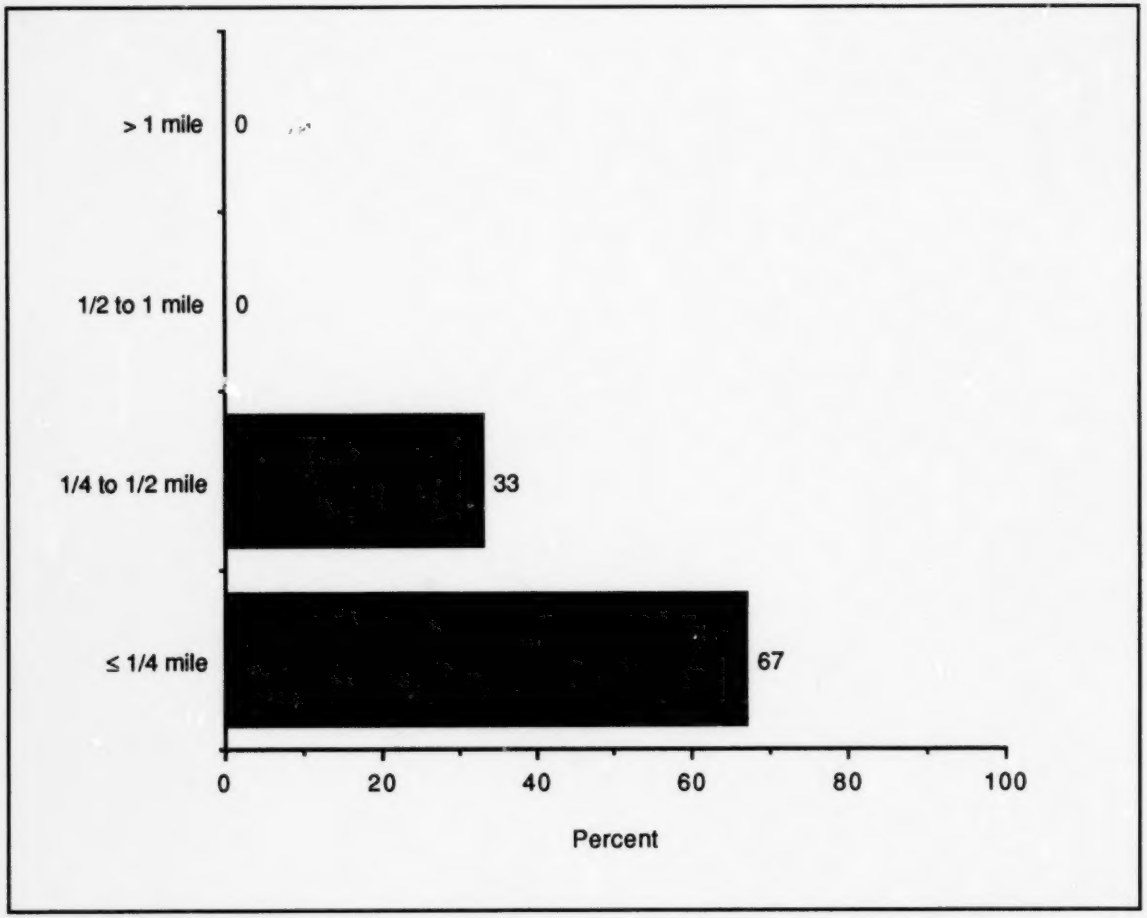

Figure 7. Distance of 3 Delaware sanitary landfills to either the closest wetland or deepwater habitat.

TABLE 1. DEFINITION OF WETLANDS USED BY THE U.S. FISH AND WILDLIFE SERVICE FROM COWARDIN ET AL. (1979)

Definition:	Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.
Explanation:	The term wetland includes a variety of areas that fall into one of five categories: (1) areas with hydrophytes and hydric soils, such as those commonly known as marshes, swamps, and bogs; (2) areas without hydrophytes but with hydric soils-for example, flats where drastic fluctuation in water level, wave action, turbidity, or high concentration of salts may prevent the growth of hydrophytes; (3) areas with hydrophytes but nonhydric soils, such as margins of impoundments or excavations where hydrophytes have become established but hydric soils have not yet developed; (4) areas without soils but with hydrophytes such as the seaweed-covered portion of rocky shores; and (5) wetlands without soil and without hydrophytes, such as gravel beaches or rocky shores without vegetation.

TABLE 1. (continued)

Limits:	The upland limit of wetland is designated as (1) the boundary between land with predominantly hydrophytic cover and land with predominantly mesophytic or xerophytic cover; (2) the boundary between soil that is predominantly hydric and soil that is predominantly nonhydric; or (3) in the case of wetlands without vegetation or soil, the boundary between land that is flooded or saturated at some time each year and land that is not. The boundary between wetland and deepwater habitat in the Marine and Estuarine systems coincides with the elevation of the extreme low water of spring tide; permanently flooded areas are considered deepwater habitats in these systems. The boundary between wetland and deepwater habitat in the Riverine, Lacustrine, and Palustrine systems lies at a depth of 2 m (6.6 feet) below low water; however, if emergents, shrubs, or trees grow beyond this depth at any time, their deepwater edge is the boundary.

TABLE 2. DEFINITION OF DEEPWATER HABITATS USED BY THE U.S. FISH AND WILDLIFE SERVICE FROM COWARDIN ET AL. (1979)

Definition:	Deepwater Habitats are permanently flooded lands lying below the deepwater boundary of wetlands. Deepwater habitats include environments where surface water is permanent and often deep, so that water, rather than air, is the principal medium within which the dominant organisms live, whether or not they are attached to the substrate. As in wetlands, the dominant plants are hydrophytes; however, the substrates are considered nonsoil because the water is too deep to support emergent vegetation.
Explanation:	Wetlands and Deepwater Habitats are defined separately because traditionally the term wetland has not included deep permanent water; however, both must be considered in an ecological approach to classification.
Limits:	The boundary between wetland and deepwater habitat in the Marine and Estuarine systems coincides with the elevation of the extreme low water of spring tide; permanently flooded areas are considered deepwater habitats in these systems. The boundary between wetland and deepwater habitat in the Riverine, Lacustrine, and Palustrine systems lies at a depth of 2 m (6.6 feet) below low water; however, if emergents, shrubs, or trees grow beyond this depth at any time, their deepwater edge is the boundary.

TABLE 3. DEFINITIONS OF THE FIVE MAJOR SYSTEMS* (MARINE, ESTUARINE, RIVERINE, LACUSTRINE, AND PALUSTRINE**) USED BY THE U.S. FISH AND WILDLIFE SERVICE IN CLASSIFYING WETLANDS AND DEEPWATER HABITATS FROM COWARDIN ET AL. (1979)

Marine:	
	Definition:
	The Marine System consists of the open ocean overlying the continental shelf and its associated high-energy coastline. Marine habitats are exposed to the waves and currents of the open ocean and the water regimes are determined primarily by the ebb and flow of oceanic tides. Salinities exceed 30 $^{o}/_{oo}$ with little or no dilution except outside the mouths of estuaries. Shallow coastal indentations or bays without appreciable freshwater inflow, and coasts with exposed rocky islands that provide the mainland with little or no shelter from wind and waves, are also considered part of the Marine System because they support typical marine biota.
	Limits:
	The Marine System extends from the outer edge of the continental shelf shoreward to one of three lines: (1) the landward limit of tidal inundation (extreme high water of spring tides), including the splash zone from breaking waves; (2) the seaward limit of wetland emergents, trees, or shrubs; or (3) the seaward limit of the Estuarine System, where this limit is determined by factors other than vegetation.

* The term system refers to a complex of wetlands and deepwater habitats that shares the influence of similar hydrologic, geomorphologic, chemical, or biological factors.

** The first four systems, i.e., Marine, Estuarine, Riverine, and Lacustrine, include both wetland and deepwater habitats whereas the Palustrine System includes only wetland habitats.

TABLE 3. (continued)

Estuarine:

Definition:

The Estuarine System consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semienclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land. The salinity may be periodically increased above that of the open ocean by evaporation. Along some low-energy coastlines there is appreciable dilution of sea water. Offshore areas with typical estuarine plants and animals, such as red mangroves (*Rhizophora mangle*) and eastern oysters (*Crassostrea virginica*), are also included in the Estuarine System.

Limits:

The Estuarine System extends (1) upstream and landward to where ocean-derived salts measure less than 0.5 $^{o}/_{oo}$ during the period of average annual low flow; (2) to an imaginary line closing the mouth of a river, bay, or sound; and (3) to the seaward limit of wetland emergents, shrubs, or trees where they are not included in (2). The Estuarine System also includes off-shore areas of continuously diluted sea water.

TABLE 3. (continued)

Riverine:

Definition:

The Riverine System includes all wetlands and deepwater habitats contained within a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean-derived salts in excess of 0.5 $^{o}/_{oo}$. A channel is "an open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water" (Langbein and Iseri, 1960).

Limits:

The Riverine System is bounded on the landward side by upland, by the channel bank (including natural and man-made levees), or by wetland dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. In braided streams, the system is bounded by the banks forming the outer limits of the depression within which the braiding occurs. The Riverine System terminates at the downstream end where the concentration of ocean-derived salts in the water exceeds 0.5 $^{o}/_{oo}$ during the period of annual average low flow, or where the channel enters a lake. It terminates at the upstream end where tributary streams originate, or where the channel leaves a lake. Springs discharging into a channel are considered part of the Riverine System.

TABLE 3. (continued)

Lacustrine:

Definition:

The Lacustrine System includes wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30% areal coverage; and (3) total area exceeds 8 ha (20 acres). Similar wetland and deepwater habitats totaling less than 8 ha are also included in the Lacustrine System if an active wave-formed or bedrock shoreline feature makes up all or part of the boundary, or if the water depth in the deepest part of the basin exceeds 2 m (6.6 feet) at low water. Lacustrine waters may be tidal or nontidal, but ocean-derived salinity is always less than 0.5 $^{o}/_{oo}$.

Limits:

The Lacustrine System is bounded by upland or by wetland dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. Lacustrine systems formed by damming a river channel are bounded by a contour approximating the normal spillway elevation or normal pool elevation, except where Palustrine wetlands extend lakeward of the boundary. Where a river enters a lake, the extension of the Lacustrine shoreline forms the Riverine-Lacustrine boundary.

TABLE 3. (continued)

Palustrine:

Definition:

The Palustrine System includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 $^{o}/_{oo}$. It also includes wetlands lacking such vegetation, but with all of the following four characteristics: (1) area less than 8 ha (20 acres); (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of basin less than 2 m at low water; and (4) salinity due to ocean-derived salts less than 0.5 $^{o}/_{oo}$.

Limits:

The Palustrine System is bounded by uplands or by any of the other four systems.

TABLE 4. NUMBER AND PERCENTAGE OF SANITARY LANDFILLS IN DELAWARE THAT ARE PROXIMATE TO WETLANDS*

	Number and percentage of sanitary landfills					
	Located in or within 1/4 mile		Located in or within 1/2 mile		Located in or within 1 mile	
Wetland system	No.	%	No.	%	No.	%
All systems**	2	66.7	3	100.0	3	100.0
Marine	0	0.0	0	0.0	0	0.0
Estuarine	1	33.3	1	33.3	1	33.3
Riverine	0	0.0	0	0.0	0	0.0
Lacustrine	0	0.0	0	0.0	0	0.0
Palustrine	1	33.3	3	100.0	3	100.0

* There are 3 sanitary landfills in the DPRA data file for the state of Delaware and all of these facilities have NWI maps available for site interpretation.

** None of the 3 sanitary landfills included in this study in the state of Delaware are located more than a mile from any type of wetland.

TABLE 5. NUMBER AND PERCENTAGE OF SANITARY LANDFILLS IN DELAWARE THAT ARE PROXIMATE TO DEEPWATER HABITATS*

Deepwater habitat system	Number and percentage of sanitary landfills					
	Located in or within 1/4 mile		Located in or within 1/2 mile		Located in or within 1 mile	
	No.	%	No.	%	No.	%
All systems**	1	33.3	1	33.3	2	66.7
Marine	0	0.0	0	0.0	0	0.0
Estuarine	0	0.0	1	33.3	1	33.3
Riverine	1	33.3	1	33.3	2	66.7
Lacustrine	0	0.0	0	0.0	0	0.0

* There are 3 sanitary landfills in the DPRA data file for the state of Delaware and all of these facilities have NWI maps available for site interpretation.

** One (33.3 percent) of the 3 sanitary landfills included in this study in the state of Delaware are located more than a mile from any type of deepwater habitat.

TABLE 6. NUMBER AND PERCENTAGE OF SANITARY LANDFILLS IN DELAWARE THAT ARE PROXIMATE TO EITHER WETLANDS OR DEEPWATER HABITATS*

	Number and percentage of sanitary landfills					
	Located in or within 1/4 mile		Located in or within 1/2 mile		Located in or within 1 mile	
System	No.	%	No.	%	No.	%
All systems**	2	66.7	3	100.0	3	100.0
Marine	0	0.0	0	0.0	0	0.0
Estuarine	1	33.3	1	33.3	1	33.3
Riverine	1	33.3	1	33.3	2	66.7
Lacustrine	0	0.0	0	0.0	0	0.0
Palustrine***	1	33.3	3	100.0	3	100.0

* There are 3 sanitary landfills in the DPRA data file for the state of Delaware and all of these facilities have NWI maps available for site interpretation.

** None of the 3 sanitary landfills included in this study in the state of Delaware are located more than a mile from any type of wetland or deepwater habitat.

*** The Palustrine system includes only wetlands.